SQ **PHILIPS** **E188CC**

SPECIAL QUALITY, LONG LIFE, SHOCK AND VIBRATION RESISTANT DOUBLE TRIODE with anti-microphonic construction for use in R.F. or A.F. circuits as cascode amplifier, cathode follower, etc.

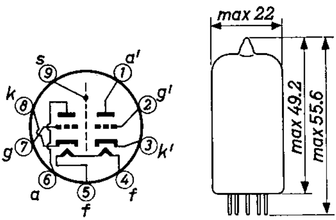
The E188CC has separate cathodes and will maintain its emission capabilities after long periods of operation under cut-off conditions.

HEATING

Indirect by A.C. or D.C.; parallel supply

Heater voltage V_f = 6.3 V

Heater current I_f = 335 mA



Base: NOVAL with gold plated pins
(Dimensions in mm)

CHARACTERISTICS

Column I: Setting of the tube and typical (average) measuring results of new tubes
II: Characteristics range values for equipment design
III: Data indicating the end of life

Heater current

		I	II	III	
Heater voltage	V_f =	6.3			V
Heater current	I_f =	335	318-352	318-352	mA

Capacitances (without external shield)

		I	II	
Anode to all other elements except grid	$C_{a(k+f+s)}$ =	1.75	1.55-1.95	pF
	$C_{a'(k'+f+s)}$ =	1.65	1.45-1.85	pF
Anode to cathode and heater	$C_{a(k+f)}$ =	0.5	0.4-0.6	pF
	$C_{a'(k'+f)}$ =	0.4	0.3-0.5	pF

CHARACTERISTICS (continued)

Capacitances (continued)

		I	II	
→ Grid to all other elements except anode	$C_{g(k+f+s)}$ =	3.3	2.7-3.9	pF
	$C_{g'(k'+f+s)}$ =	3.3	2.7-3.9	pF
→ Grid to cathode and heater	$C_{g(k+f)}$ =	3.3	2.7-3.9	pF
	$C_{g'(k'+f)}$ =	3.3	2.7-3.9	pF
Anode to grid	C_{ag} =	1.4	1.2-1.6	pF
	$C_{a'g'}$ =	1.4	1.2-1.6	pF
Anode to all other elements except cathode	$C_{a(g+f+s)}$ =	3.0	2.7-3.3	pF
	$C_{a'(g'+f+s)}$ =	2.9	2.6-3.2	pF
Cathode to all other elements except anode	$C_{k(g+f+s)}$ =	6.0	5.1-6.9	pF
	$C_{k'(g'+f+s)}$ =	6.0	5.1-6.9	pF
Anode to cathode	C_{ak} =	0.18	0.14-0.22	pF
	$C_{a'k'}$ =	0.18	0.14-0.22	pF
Anode to screen	C_{as} =	1.3	1.1-1.5	pF
	$C_{a's}$ =	1.3	1.1-1.5	pF
Cathode to heater	C_{kf} =	2.6		pF
	$C_{k'f}$ =	2.7		pF
→ Anode to anode of other section	$C_{aa'}$ =	0.025	< 0.045	pF
Grid to grid of other section	$C_{gg'}$ =		< 0.005	pF
Anode to grid of other section	$C_{ag'}$ =		< 0.005	pF
	$C_{a'g}$ =		< 0.005	pF
Grid to cathode of other section	$C_{gk'}$ =		< 0.005	pF
	$C_{g'k}$ =		< 0.005	pF

CHARACTERISTICS (continued)

Typical characteristics

			I	II	III	
Anode supply voltage	V_{ba}	=	100			V [1]
Grid supply voltage	V_{bg}	=	+9			V [1]
Cathode resistor	R_k	=	680			Ω [1]
Anode current	I_a	=	15	14.2-15.8	13.5	mA
Mutual conductance	S	=	12.5	10.5-14.5	9	mA/V
Amplification factor	μ	=	33			
Equivalent noise resistance	R_{eq}	=	250			Ω [2]
Noise factor	F	=	4.6			dB [3]
Input damping at f = 100 Mc/s	r_g	=	3			kΩ

			I	II	III	
Anode supply voltage	V_{ba}	=	90			V
Cathode resistor	R_k	=	120			Ω
Anode current	I_a	=	12			mA
Mutual conductance	S	=	11.5			mA/V

Hum voltage (referred to grid)

Measured with straight response curve filter; frequency of heater supply voltage 50 c/s + 3% 500 c/s; tubeholder fully screened.

			I	II	
Anode supply voltage	V_{ba}	=	90		V
Anode current	I_a	=	15		mA
Cathode resistor	R_k	=	80		Ω
Cathode capacitor	C_k	=	1000		μF
Grid resistor	R_g	=	0.5		MΩ
Hum voltage	V_{ghum}	=		< 50	μV

[1] Operation of the tube under these conditions is recommended because of the small spread in characteristics

[2] Measured at f = 45 Mc/s

[3] Measured in a cascode circuit matched for minimum noise at f = 200 Mc/s

CHARACTERISTICS (continued)

Negative grid current

			I	II	III	
Anode supply voltage	V_{ba}	=	100			V
Grid supply voltage	V_{bg}	=	+9			V
Cathode resistor	R_k	=	680			Ω
Grid resistor	R_g	=	0.1			MΩ
Negative grid current	$-I_g$	=		< 0.1	1.0	µA

Vibrational noise output

			I	II	III	
Anode supply voltage	V_{ba}	=	100			V
Anode resistor	R_a	=	2			kΩ
Grid supply voltage	V_{bg}	=	+9			V
Cathode resistor	R_k	=	680			Ω
Cathode capacitor	C_k	=	1000			µF
Vibrational frequency	f	=	10-50			c/s
Vibrational acceleration		=	2.5			g
Vibrational noise output	V	=		< 100		mV

			I	II	III	
Anode supply voltage	V_{ba}	=	270			V
Anode resistor	R_a	=	18			kΩ
Grid resistor	R_g	=	1			MΩ
Cathode resistor	R_k	=	180			Ω
Cathode oapacitor	C_k	=	50			µF
Vibrational frequency	f	=	50-5000			c/s
Vibrational acceleration		=	0.5			g
Vibrational noise output	V	=		< 140		mV

CHARACTERISTICS (continued)

Heater to cathode insulation

			I	II	III	
Heater voltage	V_f	=	6.3			V
Voltage between heater and cathode (cathode negative)	V_{kf}	=	60			V
Heater to cathode current	I_{kf}	=		< 6	12	µA

			I	II	III	
Heater voltage	V_f	=	6.3			V
Voltage between heater and cathode (cathode positive)	V_{kf}	=	120			V
Cathode to heater current	I_{kf}	=		< 6	12	µA

Insulation between two arbitrary electrodes

When measured between an electrode and cathode, the cathode should be positive

			I	II	III	
Voltage	V	=	200			V
Insulation resistance	R_{isol}	=		>100	20	MΩ

SHOCK RESISTANCE: about 500 g [1])

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30° in each of four different positions of the tube

VIBRATION RESISTANCE: 2.5 g [1])

Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of the three main directions

LIFE EXPECTANCY: 10 000 hours under the following life-test conditions:

Heater voltage	V_f	= 6.3 V
Anode supply voltage	$V_{ba} = V_{ba}'$	= 100 V
Grid supply voltage	$V_{bg} = V_{bg}'$	= +9 V
Cathode resistor	$R_k = R_k'$	= 680 Ω
Grid resistor	$R_g = R_g'$	= 47 kΩ
Voltage between cathode and heater (cathode negative)	$V_{kf} = V_{k'f}$	= 60 V

The data indicating the end point of life are given in column III under the heading "Characteristics"

[1]) These test conditions are only given for evaluation of the ruggedness of the tube and should by no means be interpreted as suitable operating conditions

OPERATING CHARACTERISTICS AS OUTPUT TUBE CLASS A

Anode voltage	V_a	=		220		V
Load resistance	$R_{a\sim}$	=		20		kΩ
→ Grid bias	V_g	=		-6.5		V
Input voltage	V_i	=	0	1.5	4.5	V(RMS)
Anode current	I_a	=	6.5	-	9.2	mA
Output power	W_o	=	0	0.05	0.5	W
Total distortion	d_{tot}	=	-	-	7	%

OPERATING CHARACTERISTICS AS PUSH-PULL OUTPUT TUBE CLASS B (sinusoidal input voltage)

Anode voltage	V_a	=		200		V
Load resistance	$R_{aa\sim}$	=		22		kΩ
Grid bias	V_g	=		-6		V
Input voltage	V_i	=	0	0.9	4.0	V(RMS)
Anode current	I_a	=	2x5.0	-	2x9	mA
Output power	W_o	=	0	0.05	1.2	W
Total distortion	d_{tot}	=	-	-	3	%

OPERATING CHARACTERISTICS AS PUSH-PULL OUTPUT TUBE CLASS B (speech and music signals)

These values have been measured with sinusoidal input voltage. With full drive, however, the maximum permissible anode dissipation is exceeded. Therefore, operation with a sinusoidal input voltage is not allowed in this setting. When, however, the tube is operated with normal speech and music signals, the RMS-value of the input voltage will generally be less than 4 V so that in this case no overload of the tube will occur

Anode voltage	V_a	=		200		V
Load resistance	$R_{aa\sim}$	=		10		kΩ
Grid bias	V_g	=		-6		V
Input voltage	V_i	=	0	0.9	4.0	V(RMS)
Anode current	I_a	=	2x5.0	-	2x13.5	mA
Output power	W_o	=	0	0.05	1.5	W
Total distortion	d_{tot}	=	-	-	4	%

OPERATING CHARACTERISTICS AS ADDITIVE MIXER

Anode supply voltage	V_{ba}	= 60	90	150	V
Anode resistor	R_a	= 0	1	3.9	kΩ
Grid resistor	R_g	= 1	1	1	MΩ
Oscillator voltage	V_{osc}	= 2.0	2.5	3.0	V(RMS)
Anode current	I_a	= 4.7	7.7	11	mA
Conversion conductance	S_c	= 2.9	3.5	4.1	mA/V
Internal resistance	R_i	= 8.3	7.0	6.1	kΩ

LIMITING VALUES (Absolute limits; each section)

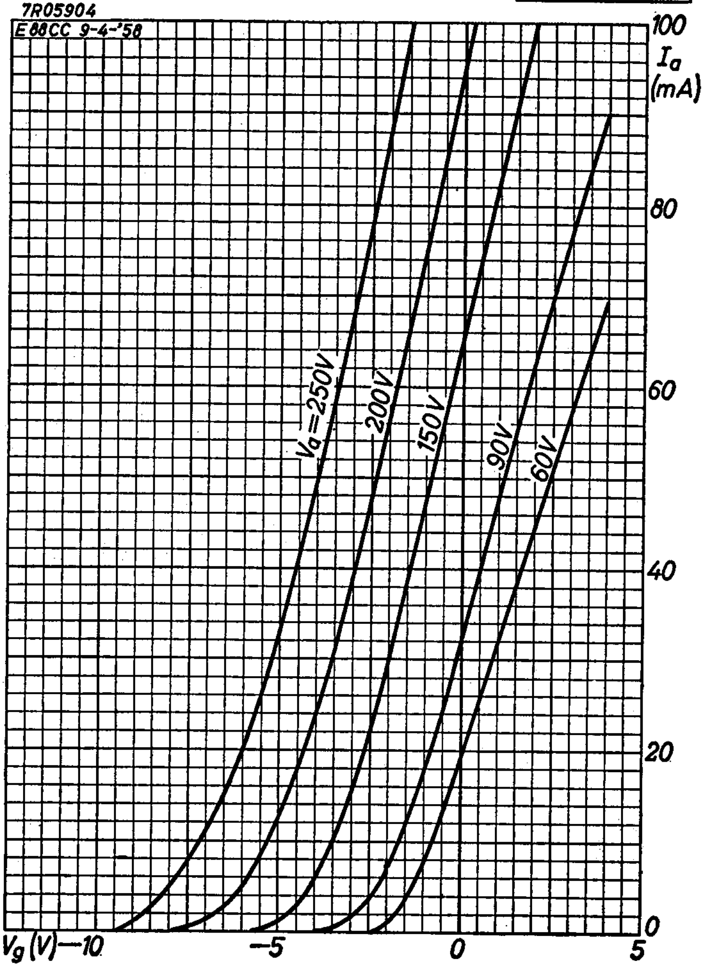
Anode voltage in cold condition	V_{ao}	= max.	550 V
Anode voltage when anode current = 0 mA	$V_a(I_a = 0)$	= max.	400 V
Anode voltage	V_a	= max.	250 V
Anode dissipation	W_a	= max.	1.65 W
Anode dissipation	W_a	= max.	2.0 W [1])
Grid dissipation	W_g	= max.	0.03 W
Negative grid voltage	$-V_g$	= max.	110 V
Peak negative grid voltage	$-V_{gp}$	= max.	200 V [2])
Cathode current	I_k	= max.	22 mA
Peak cathode current	I_{kp}	= max.	110 mA[2])
Heater to cathode voltage			
cathode positive	V_{kf}	= max.	150 V
cathode negative	V_{kf}	= max.	100 V
Heater voltage	V_f	=	6.3 V ± 5 %
Bulb temperature	t_{bulb}	= max.	165 °C

MAX.CCIRCUIT VALUES

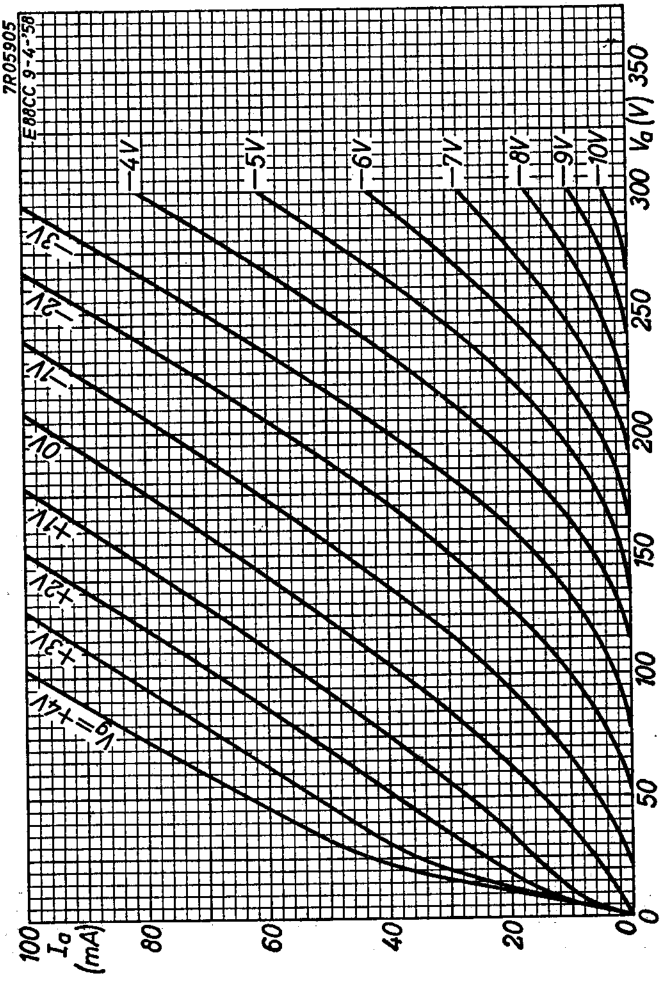
Grid resistor with automatic bias	R_g	= max.	1 MΩ
Grid resistor with fixed bias	R_g	= max.	0.5 MΩ

[1]) When $W_a+W_{a'}$ is less than 2.2 W

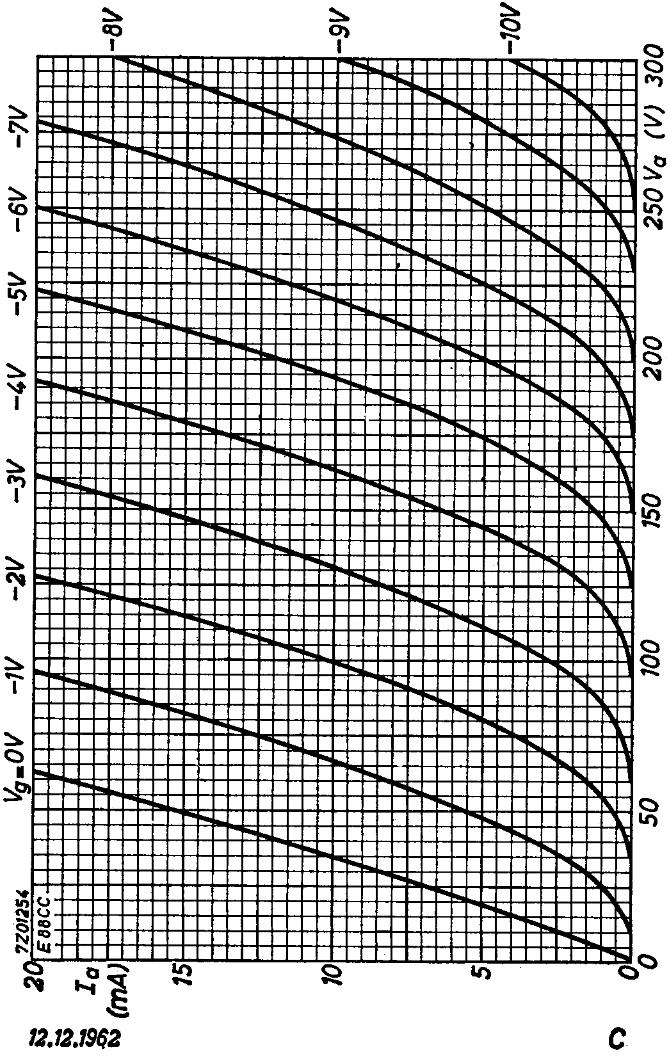
[2]) Pulse duration max. 200 μsec, duty factor max. 10 %


7R05904
E 88CC 9-4-'58
100
I_a (mA)
80
60
40
20
0
V_a=250V
200V
150V
90V
60V
V_g (V) —10
—5
0
5

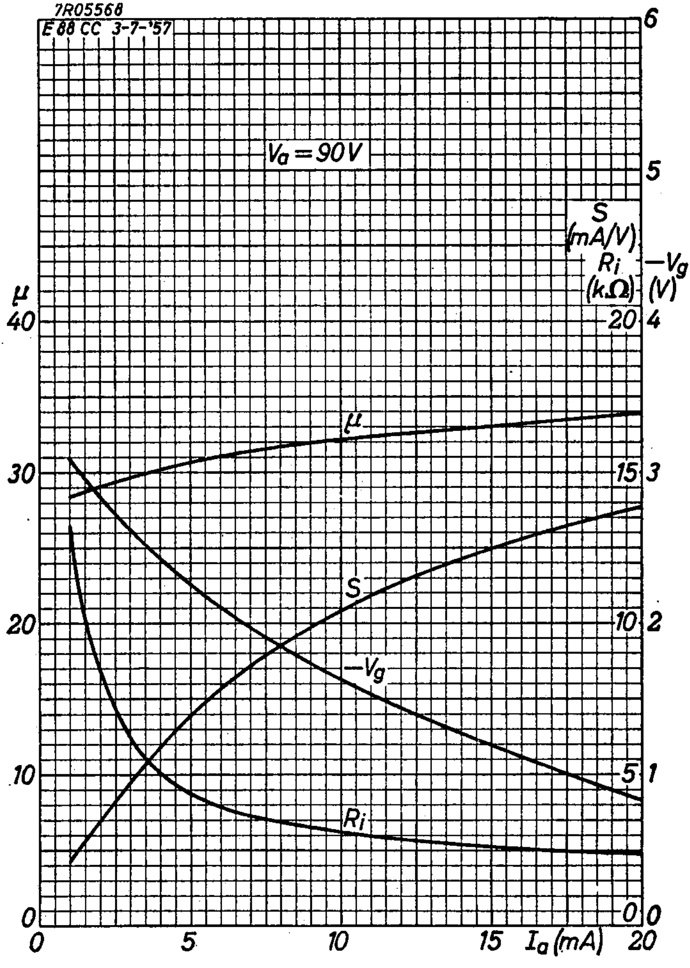
E188CC **PHILIPS** SQ



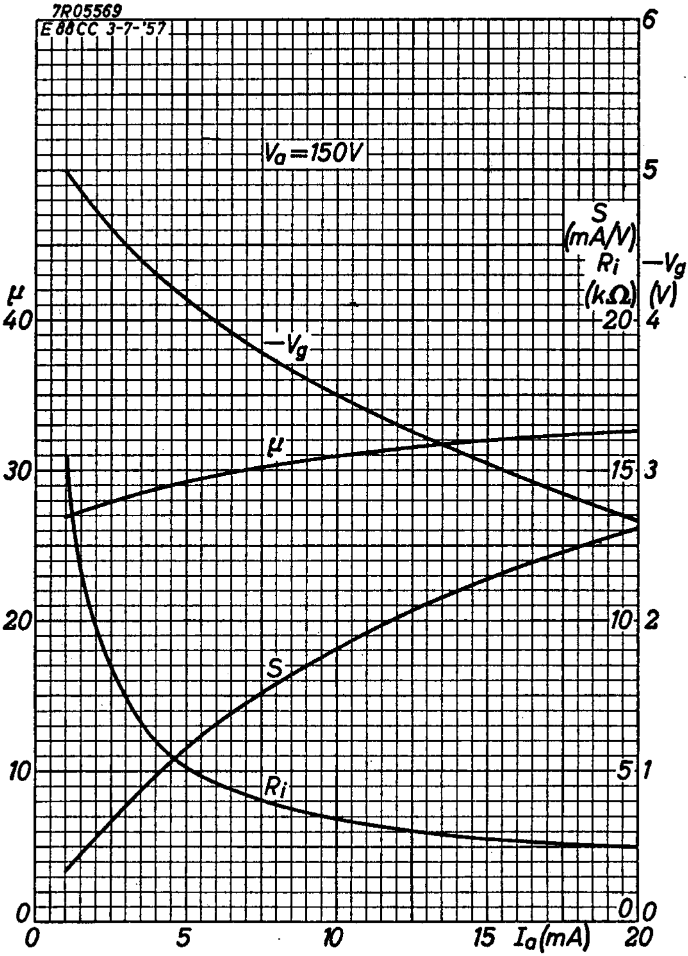
SQ **PHILIPS** **E188CC**

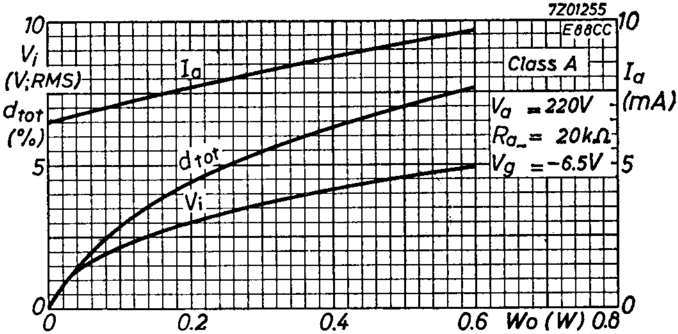


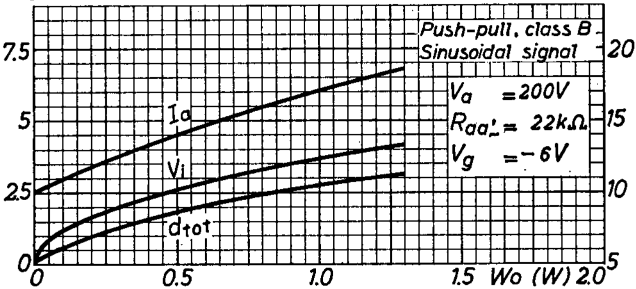
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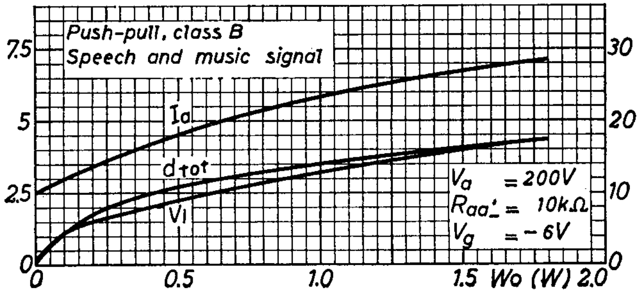

7R05568
E 88 CC 3-7-'57
$V_a = 90V$
μ
S
$-V_g$
R_i
μ
40
30
20
10
0
S (mA/V)
R_i (kΩ)
$-V_g$ (V)
6
5
20 4
15 3
10 2
5 1
0 0
0
5
10
15
I_a (mA)
20

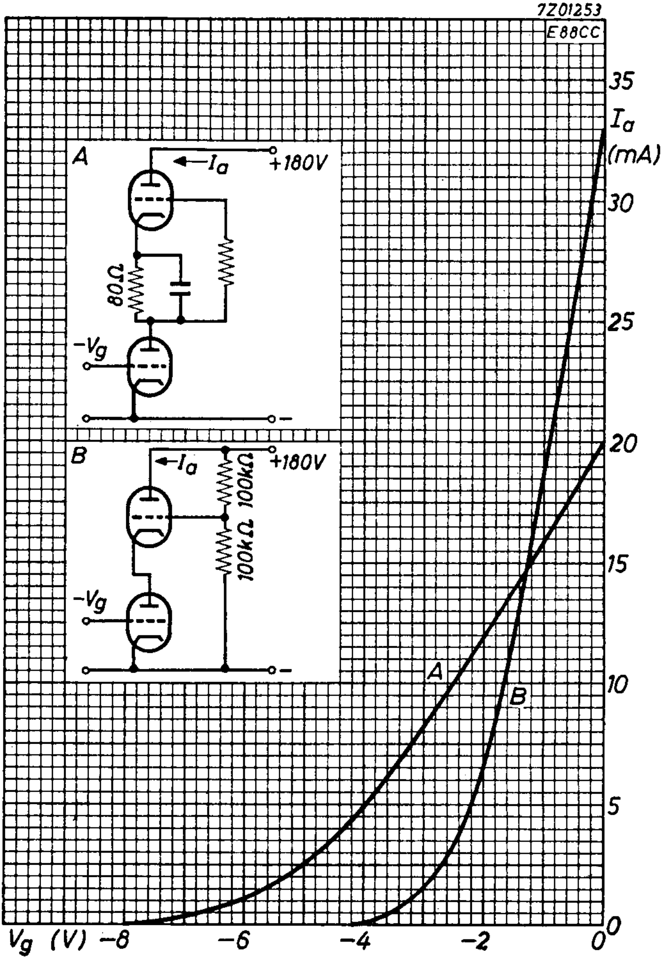
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7Z01255
E88CC
Class A
V_a = 220V
$R_{a\sim}$ = 20kΩ
V_g = −6.5V
V_i (V;RMS)
d_{tot} (%)
I_a (mA)
I_a
d_{tot}
V_i
Wo (W)
0
0.2
0.4
0.6
0.8
5
10


Push-pull, class B
Sinusoidal signal
V_a = 200V
$R_{aa\sim}$ = 22kΩ
V_g = −6V
I_a
V_i
d_{tot}
Wo (W)
0
0.5
1.0
1.5
2.0
2.5
5
7.5
10
15
20


Push-pull, class B
Speech and music signal
V_a = 200V
$R_{aa\sim}$ = 10kΩ
V_g = −6V
I_a
d_{tot}
V_i
Wo (W)
0
0.5
1.0
1.5
2.0
2.5
5
7.5
10
20
30


7Z01253
E88CC
A
I_a
+180V
80Ω
$-V_g$
–
B
I_a
+180V
100kΩ
100kΩ
$-V_g$
–
A
B
35
30
25
20
15
10
5
0
I_a (mA)
V_g (V) −8 −6 −4 −2 0

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Electronic Tube HANDBOOK

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